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Melastoma Affine D.Don Compost as a Substitute for Synthetic N Fertilizer in Sweet Corn

Hanipah Irbah Yuliana[1], Nanik Setyowati[2], Zainal Muktamar[3], Kartika Utami[4], Marwanto[5], M. Chozin[6]
[1]Agroecotechnology Study Program, University of Bengkulu, Indonesia
[2,5,6] Department of Crop Production, University of Bengkulu, Indonesia
[3,4]Department of Soil Science, University of Bengkulu, Indonesia

ABSTRACT

The study aims to compare various combinations of Melastoma compost and synthetic nitrogen fertilizer and evaluate their effects on plant growth and yield of sweet corn (*Zea mays* var. saccharata). The experiment was conducted in a greenhouse using a Completely Randomized Design (CRD) with one factor consisting of five fertilizer combinations, namely P_1 (100% N), P_2 (25% compost + 75% N), P_3 (50% compost + 50% N), P_4 (75% compost + 25% N), and P_5 (100% compost). Each treatment was repeated four times. Plant growth parameters (height, number of leaves, leaf area, and stem diameter) and cob yield (weight, length, and kernel characteristics) were measured. The findings revealed that P_3 (50% compost + 50% N) resulted in better plant growth, exhibiting significantly greater height, a higher number of leaves, and a larger diameter than P_1. Meanwhile, no significant differences were observed between P_2, P_3, and P_4, suggesting that compost can partially substitute synthetic fertilizer without negatively affecting plant growth. Using 100% compost (P_5) resulted in significantly lower cob yields than all other treatments. The study concluded that combining *Melastoma affine* compost with synthetic nitrogen fertilizer improves sweet corn growth while maintaining cob weight. A 50:50 ratio of compost and synthetic nitrogen (P_3) was the most effective combination. However, using 100% compost (P_5) led to poor plant growth and yield, likely due to allelopathic effects. Further research is necessary to explore strategies to mitigate these effects for optimal compost utilization.

KEYWORDS: Sweet corn, *Melastoma affine* compost, synthetic nitrogen, plant growth, cob weight, allelopathy.

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Corresponding Author:
Nanik Setyowati

1. INTRODUCTION

In Indonesia, sweet corn production is still at a lower level than its potential. Farmers should adopt better seed varieties, optimize fertilizer use, and implement efficient irrigation and pest management systems to increase productivity. While the proper use of fertilizers can enhance sweet corn growth (Setyowati *et al*., 2022), improper use of synthetic fertilizers can harm both human health and the environment (Adekiya *et al*., 2020), making organic fertilizers a sustainable alternative (Liu *et al*., 2018).

Using organic fertilizers can enhance soil structure, increase enzyme activity in the soil, accelerate the decomposition of organic matter, and ensure nutrient availability during the final phases of cereal growth, all of which lead to higher crop yields (Wang *et al*., 2024). Nitrogen (N) is essential among the key nutrients for improving and sustaining crop productivity (Li *et al*., 2023; Yang *et al*., 2015). It is vital to meet the growing global food demand due to population growth (Yang *et al*., 2015). However, nitrogen fertilizers' success largely depends on the type of fertilizer applied, making proper fertilizer management essential in agricultural systems.

Research has indicated that organic fertilizers are less effective than NPK mineral fertilizers in corn farming, implying that organic fertilizers cannot wholly replace synthetic fertilizers (Zapałowska & Jarecki, 2024). As a result, a combination of both types is required. Using synthetic and organic fertilizers decreases reliance on synthetic fertilizers and improves nitrogen uptake, benefiting environmental quality (Moe *et al*., 2017). This mixture also helps optimize nitrogen management by soil microorganisms, ensuring a balanced supply of nutrients for plants (Khan *et al*., 2022).

Organic fertilizers, derived from materials such as animal waste and plant biomass, are essential for sustainable farming practices (Nurwati., 2017). Hamidah (2023) suggests that plant materials like rice straw, dry leaves, household waste, plant biomass, and weeds can be used to meet nutrient needs. One example is *Melastoma affine* D. Don (Haredong), a weed commonly found in swampy, forested, and grassy areas at elevations up to 2,500 meters above sea level (Syafitri *et al*., 2014). This weed contains essential nutrients, including nitrogen (N), phosphorus (P), and potassium (K), with a composition of 2.27% total nitrogen, 0.29% phosphorus, 1.10% potassium, and 53.63% organic carbon. Incorporating weed compost into agricultural systems has improved crop yields and soil quality while reducing reliance on synthetic fertilizers (Muktamar, 2016; Setyowati *et al*., 2015). Compost derived from weeds can be applied to various plants, including sweet corn. The study aims to compare various combinations of Melastoma compost and synthetic nitrogen fertilizer and evaluate their effects on plant growth and yield of sweet corn (*Zea mays* var. saccharata).

II. MATERIALS AND METHODS

The research was conducted in 2024 at the greenhouse of the Agronomy Laboratory, Faculty of Agriculture, University of Bengkulu, Indonesia. The study included six treatments, organized using a Completely Randomized Design (CRD) with one factor. The treatments were P_1: 0% compost + 100% N; P_2: 25% compost + 75% N; P_3: 50% compost + 50% N; P_4: 75% compost + 25% N; P_5: 100 % compost + 0% N. Each treatment was repeated four times, resulting in 24 experimental units. Each unit contained two sub-samples, totaling 48 plants.

The study began with compost preparation using 500 kg of *Melastoma affine* D. Don weeds collected from various locations. The weeds were chopped to facilitate decomposition. The composting mixture was prepared by diluting 10 cc of EM4 (Effective Microorganisms) per liter of water, adding 5 kg of manure, and thoroughly mixing the components. The mixture was then covered with a tarpaulin to maintain optimal humidity and temperature. The composting process lasted eight weeks, with the pile being turned every three days to ensure aeration and uniform decomposition (Figure 1). Once fully decomposed, the compost was sieved, and its nutrient content was analyzed. The analysis shows that the Melastoma compost contained 46.4% carbon (C), 2.84% nitrogen (N), 0.54% phosphorus (P), and 1.75% potassium (K) and had a pH of 7.81.

(a) (b) (c) (d) (e)

Figure 1. Melastoma compost processing: Melastoma before and after chopped (a), grinding process (b), adding manure and EM4 (c), pilling up for decomposition process (d), mature compost (e)

The soil sample used in this study was Inceptisols, collected from Padang Betuah, Pondok Kelapa District, Central Bengkulu Regency, Indonesia. The soil was taken from 0–20 cm depth, air-dried for two days, and sieved using a 5 mm mesh. Additionally, composite soil samples were collected from five points in a zigzag pattern at 0–20 cm depth, air-dried for two days, sieved with a 2 mm mesh, and thoroughly mixed and analyzed for initial characteristics. At the Soil Science Laboratory, University of Bengkulu. The soil content of organic carbon is 2.29%, total nitrogen 0.29%, available phosphorus 4.34 ppm, exchangeable potassium 0.35 cmol/kg, sand 60.31%, clay 18.84%, silt 20.84%, and pH of 4.54.

The planting medium consisted of 10 kg of Inceptisols mixed with compost, placed into 40 cm × 50 cm polybags, and arranged randomly in a greenhouse with a 75 cm × 20 cm spacing. Melastoma compost is incorporated into the planting medium one week before planting, while synthetic fertilizer is applied three days prior to planting. The P1 synthetic fertilizer treatment consisted of 250 kg/ha of Urea (155 kg N/ha), 200 kg/ha of SP-36 (72 kg P/Ha), and 150 kg/ha of KCl (90 kg K/ha). The 100% N treatment means 155 kg N/ha or equal to 3.39 g N/plant. Treatments P2, P3, P4, and P5 each received 100% dose of P and K.

Two sweet corn seeds of the Bonanza variety were sown per hole to a 2–3 cm depth. Two weeks after planting (WAP), thinning was conducted, leaving one plant per polybag. Weeding was performed manually by hand-pulling weeds, irrigation was applied twice daily, and pest and disease management was carried out using insecticides and fungicides. Harvesting occurred 80 days after planting (DAP), when the cobs were fully mature, indicated by the kernels releasing a thick white liquid and the cob hairs turning brown. Harvesting was done manually.

After harvesting, soil samples were collected from each polybag, and 50 grams were taken using a soil probe. The samples were then sieved and analyzed for total nitrogen (N) content using Kedjdahl Methode and pH at a ratio of 1:1 of soil and distilled water using a pH meter.

III. RESULTS

The research findings on replacing synthetic nitrogen fertilizer with Melastoma compost in sweet corn cultivation are presented in Tables 1 to 5. Table 1 illustrates the impact of Melastoma compost, synthetic fertilizer, and their combination on soil pH and nitrogen content at the end of the study. Tables 2 and 3 present the growth characteristics of sweet corn, while Tables 4 and 5 illustrate its yield characteristics.

Table 1. Effect of Melastoma compost, synthetic fertilizers, and their combinations on total nitrogen content and soil pH.

Treatment	Total Nitrogen	Soil pH
P_1	0.31	4.65
P_2	0.28	4.73
P_3	0.29	4.85
P_4	0.35	4.91
P_5	0.36	5.18
Contras test	Probability	
P_1 - P_2	0.2192	0.1037
P_1 - P_3	0.4273	0.0008
P_1 - P_4	0.0662	<0.0001
P_1 - P_5	0.0272	<0.0001
P_2 - P_3	0.6477	0.0261
P_2 - P_4	0.0052	0.0018
P_2 - P_5	0.0020	<0.0001
P_3 - P_4	0.0135	0.2092
P_3 - P_5	0.0052	<0.0001
P_4 - P_5	0.6477	<0.0001

Note: P_1: 0% Compost + 100% N; P_2: 25% Compost + 75% N; P_3: 50% Compost + 50% N; P_4: 75% Compost + 25% N; P_5: 100 % Compost + 0% N.

The data (Tabel 1) shows that the Total Nitrogen content in the soil ranges from 0.28% to 0.36%, with the lowest value in treatment P_2 (0.28%) and the highest value in P_5 (0.36%). In general, the nitrogen content tends to increase from P_1 to P5. Meanwhile, the soil pH value is in the range of 4.65 to 5.18, with the highest acidity level in P_1 (pH 4.65) and the closest to neutral in P_5 (pH 5.18). There is a trend of increasing soil pH and the treatment from P_1 to P_5. Overall, these results indicate that the fertilizer combination treatment has the potential to increase nitrogen levels in the soil while increasing soil pH, gradually reducing acidity levels.

Table 2. Effect of Melastoma compost and synthetic fertilizer combination on sweet corn height, number of leaves, leaves area, stem diameter, and leaf greenness.

Treatment	Plant Height (cm)	Number of Leaves	Leaves Area (cm²)	Stem Diameter (mm)	Leaf greenness
P_1	159.37	12.75	527.41	18.89	51.46
P_2	181.75	13.75	650.36	21.78	46.34
P_3	186.75	15.00	702.28	21.97	43.47
P_4	180.75	14.75	702.03	20.41	42.75
P_5	174.50	14.25	606.41	20.01	33.18

Contras test	Probability				
P_1 - P_2	0.0095	0.0271	0.0003	0.1116	0.1116
P_1 - P_3	0.0024	<0.0001	<0.0001	0.0185	0.0185
P_1 - P_4	0.0124	0.0002	<0.0001	0.0115	0.0115
P_1 - P_5	0.0628	0.0023	0.0083	<0.0001	<0.0001
P_2 - P_3	0.5165	0.0079	0.0644	0.3573	0.3573
P_2 - P_4	0.8961	0.0271	0.0656	0.2534	0.2534
P_2 - P_5	0.3506	0.2396	0.1118	0.0006	0.0006
P_3 - P_4	0.4377	0.5495	0.9926	0.8152	0.8152
P_3 - P_5	0.1244	0.0861	0.0022	0.0040	0.0040
P_4 - P_5	0.4195	0.2396	0.0022	0.0065	0.0065

Note: P_1: 0% Compost + 100% N; P_2: 25% Compost + 75% N; P_3: 50% Compost + 50% N; P_4: 75% Compost + 25% N; P_5: 100 % Compost + 0% N.

The data presented in Table 2 shows that treatment P_3 (50% compost + 50% N) gave the best results in all observed variables, including plant height, number of leaves, leaf area, and stem diameter. The level of leaf greenness decreased relatively from P_1 to P_5, with the highest level of leaf greenness in treatment P_1, which was 51.46. The orthogonal contrast test showed a significant difference ($P < 0.05$) in all variables between treatments P_1 and P_3. When compared with P_1 and P_5, significant differences ($P < 0.05$) were seen in the number of leaves, leaf area, stem diameter, and leaf greenness, although no significant differences were found in plant height. Similarly, significant differences were detected between P_3 and P_5 in leaf area and stem diameter, while plant height and number of leaves did not show significant differences.

Table 3. Effect of Melastoma compost and synthetic fertilizer combination on sweet corn shoot and root weight.

Treatment	Shoot Fresh Weight (g)	Shoot Dry Weight (g)	Root Fresh Weight (g)	Root Dry Weight (g)
P_1	158.17	43.33	57.26	25.21
P_2	190.44	47.12	68.04	27.92
P_3	201.79	57.07	70.72	27.91
P_4	202.51	56.59	69.50	26.75
P_5	171.86	46.20	66.41	25.34
Contras test	Probability			
P_1 - P_2	0.0492	0.3084	0.1397	0.5360
P_1 - P_3	0.0112	0.0017	0.0704	0.5364
P_1 - P_4	0.0102	0.0022	0.0969	0.7234
P_1 - P_5	0.3785	0.4367	0.2054	0.9757
P_2 - P_3	0.4635	0.0143	0.7030	0.9995
P_2 - P_4	0.4364	0.0188	0.8355	0.7887
P_2 - P_5	0.2368	0.8020	0.8169	0.5559
P_3 - P_4	0.9628	0.8945	0.8616	0.7892
P_3 - P_5	0.0658	0.0085	0.5418	0.5563
P_4 - P_5	0.0603	0.0112	0.6613	0.7463

Note: P_1: 0% Compost + 100% N; P_2: 25% Compost + 75% N; P_3: 50% Compost + 50% N; P_4: 75% Compost + 25% N; P_5: 100 % Compost + 0% N.

Table 3 indicates that the P_3 treatment resulted in the highest shoot dry weight and root fresh weight, while P_4 excelled in shoot fresh weight. In contrast, P_1 consistently showed the lowest values across all variables. A comparison between P_1 and P_3 revealed a highly significant difference ($P < 0.05$) in the shoot fresh and dry weights, although no significant difference ($P > 0.05$) was observed in the root fresh and dry weights. Similarly, no significant difference was found between P_1 and P_5 for all variables, including fresh and dry weights of both the shoot and roots. However, when comparing P_3 and P_5, a highly significant difference was noted in the shoot dry weight, while no significant differences were observed in the shoot fresh weight and root fresh and dry weight.

Table 4. Effect of Melastoma compost and synthetic fertilizer combination on sweet corn cob diameter, kernel row, and kernel number.

Treatment	Unhusked Cob Diameter (mm)	Husked Cob Diameter (mm)	Number of Rows per Cob	Number of Kernels per Row
P_1	44.85	42.02	13.00	31.25
P_2	45.57	42.05	13.50	29.00
P_3	45.32	41.75	15.75	26.75
P_4	44.37	40.90	14.75	25.75
P_5	41.87	39.00	14.75	18.25
Contrast	Probability			
P_1 - P_2	0.7617	0.9907	0.5419	0.5241
P_1 - P_3	0.8424	0.8976	0.0037	0.2117
P_1 - P_4	0.8424	0.6003	0.0452	0.1317
P_1 - P_5	0.2244	0.1706	0.0452	0.0019
P_2 - P_3	0.9166	0.8884	0.0132	0.5241
P_2 - P_4	0.6167	0.5923	0.1395	0.3611
P_2 - P_5	0.1359	0.1673	0.1395	0.0071
P_3 - P_4	0.6915	0.6916	0.2310	0.7759
P_3 - P_5	0.1624	0.2104	0.2310	0.0263
P_4 - P_5	0.3038	0.3802	1.0000	0.0461

Note: P_1: 0% Compost + 100% N; P_2: 25% Compost + 75% N; P_3: 50% Compost + 50% N; P_4: 75% Compost + 25% N; P_5: 100 % Compost + 0% N.

Table 4 shows that the differences in treatment have no significant effect on the cob diameter. However, the P_3, P_4, and P_5 treatments resulted in more kernel rows, 15.75, 14.75, and 14.75, respectively, compared to the P_1 treatment of 13 kernel rows. Treatment P_5 produces fewer number kernels per row, 18.25, compared to treatments P_1 and P_2, 31.25 and 29.00, respectively.

Table 5. Effect of Melastoma compost and synthetic fertilizer combination on sweet corn cob length, weight, and sweetness.

Treatment	Unhusked Cob Length (cm)	Husked Cob Length (cm)	Unhusked Cob Weight (g)	Husked Cob Weight (g)	Sweetness (Brix)
P_1	22.22	17.42	166.37	139.07	10.75
P_2	22.40	16.95	156.72	132.99	11.50
P_3	22.75	17.22	172.24	139.72	11.00
P_4	23.05	17.50	154.71	119.45	11.25
P_5	20.42	13.40	107.24	86.83	12.00
Contras test	Probability				
P_1 - P_2	0.8805	0.5858	0.4264	0.6140	0.5718
P_1 - P_3	0.6530	0.8178	0.6264	0.9563	0.8498
P_1 - P_4	0.4821	0.9311	0.3390	0.1169	0.7054
P_1 - P_5	0.1366	0.0003	0.0002	0.0005	0.3506
P_2 - P_3	0.7639	0.7516	0.2084	0.5765	0.7054
P_2 - P_4	0.5785	0.5288	0.8673	0.2686	0.8498
P_2 - P_5	0.1049	0.0008	0.0008	0.0014	0.7054
P_3 - P_4	0.7968	0.7516	0.1584	0.1061	0.8498
P_3 - P_5	0.0603	0.0004	<0.0001	0.0004	0.4528
P_4 - P_5	0.0367	0.0002	0.0011	0.0144	0.5718

Note: P_1: 0% Compost + 100% N; P_2: 25% Compost + 75% N; P_3: 50% Compost + 50% N; P_4: 75% Compost + 25% N; P_5: 100 % Compost + 0% N.

There was no difference between treatments in the length of unhusked corn cobs and the level of sweetness of the fruit, but treatment P_5 produced a shorter length of husked corn cobs, which was 13.40 cm, while in other treatments it ranged from

16.95 cm to 17.50 cm, and the highest level of sweetness was 12 compared to other treatments ranging from 10.75 to 11.25. This low length of husked corn cobs is directly proportional to the low weight of the corn cobs. The weight of unhusked corn cobs in treatment P_5 was 107.24 g, while in other treatments, it ranged from 154.71 to 172.24 g, and the weight of husked corn cobs ranged from 119.45 to 139.07 g. Overall, the weight of corn cobs produced by treatments P_2, P_3, and P_4 (a mixture of synthetic fertilizer and compost) was not significantly different from N synthetic fertilizer at the recommended dose P_1 (Table 5).

IV. DISCUSSION

The results showed that corn plants fertilized with synthetic fertilizer and Melastoma compost produced better plant growth than those fertilized only with synthetic fertilizer. Corn fertilized with synthetic fertilizer and compost produces taller plants, more leaves, broader leaves, and larger stem diameters. The combination of 50% compost + 50% N (P_3) was able to increase plant height by 17,2%, number of leaves by 17,65%, leaf area by 33,2%, and stem diameter by 16,3% (Table 1) increased shoot fresh and dry weight 27,5% and 31,7% respectively (Table 2) when compared to those only fertilized with synthetic fertilizer (P_1).

Combining synthetic fertilizers and Melastoma compost improves corn plant growth compared to synthetic fertilizers alone due to several synergistic effects. Synthetic fertilizers provide readily available nutrients essential for plant growth, such as nitrogen (N), phosphorus (P), and potassium (K), which are crucial during early vegetative stages. Moreover, adding Melastoma compost enhances the soil's organic matter content, improving soil structure, aeration, and water retention. Organic matter in compost also supports the development of beneficial microorganisms that facilitate nutrient cycling and availability (Sarker *et al*., 2020; Sánchez *et al*., 2017). These combined effects create a more conducive environment for plant growth, leading to improved growth and yield of sweet corn.

In addition to enhancing soil properties, Melastoma compost contributes to a slow and steady release of nutrients, reducing the risk of nutrient leaching often associated with synthetic fertilizers. The gradual nutrient release ensures that corn plants can access nutrients throughout their growth stages, preventing deficiencies during critical periods. Compost also adds trace elements and secondary nutrients often lacking in synthetic fertilizers. According to Yang *et al*. (2019), compost application increases soil cation exchange capacity (CEC), which enhances the soil's ability to retain and supply nutrients to plants over time, supporting sustained growth and higher productivity.

Treatments P_2 (25% compost + 75% N), P_3 (50% compost + 50% N), P_4 (75% compost + 25% N), and P_5 (100% compost + 0% N) revealed no significant differences in plant height, number of leaves, leaf area, or stem diameter (Table 1). Similarly, there were no significant differences in shoot fresh weight, root fresh weight, or root dry weight (Table 2). The similar effect of fertilizer combination indicates that varying the proportion of compost and synthetic nitrogen does not significantly influence vegetative growth parameters. The absence of significant differences suggests that the compost-based nutrient supply supports plant growth, indicating any treatment combinations viable for sweet corn growth. Similar findings have been reported on shallot (Nurjanah *et al*., 2024; Setyowati *et al*., 2024), oil palm (Supanjani *et al*., 2024), cantaloupe (Suprijono *et al*., 2024), soybean (Pujiwati *et al*., 2023) and green mustard (Setyowati *et al*., 2023).

Organic compost enhances soil fertility by gradually releasing essential nutrients. It provides macronutrients like nitrogen (N), phosphorus (P), and potassium (K) for plant growth, along with calcium (Ca), magnesium (Mg), and sulfur (S) for structural and metabolic functions. Additionally, it supplies micronutrients such as iron (Fe), zinc (Zn), and boron (B), which support enzymatic and physiological processes. Compost also improves soil structure, moisture retention, and microbial activity, promoting sustainable plant development. The combination of compost and synthetic fertilizers has been reported to improve soil chemical composition and microbial populations, contributing to enhanced soil quality and rice growth (Iqbal *et al*., 2022). Combining organic manure and chemical fertilizers enhances rhizospheric soil quality and significantly increases soybean yield by improving nutrient supply and carbon cycling. This fertilizer combination more effectively alleviates microbial metabolic constraints than straw alone, making it a superior fertilization strategy (Wu *et al*., 2024). In this study, Melastoma compost contains N 2.84%, P 0.54%, K 1.75, Ca 3.57, Mg 0.58, S 0.81%, Fe 18.52 mg/kg, Cu 7.62 mg/kg, Zn 96.6 mg/kg, Mn 1720 mg/kg with C/N ratio 16.34, Cellulose 4%, Lignin 38%, Hemicellulose 6% and the pH of 7.81.

The lower weight of sweet corn cobs observed with 100% Melastoma compost compared to 100% synthetic fertilizer or a combination of synthetic fertilizer and compost could be attributed to allelopathic compounds present in Melastoma spp. Allelopathy refers to the biochemical interactions in which certain plant species release secondary metabolites that can suppress or inhibit the growth of other plants. Melastoma spp. is known to contain allelopathic compounds such as flavonoids, tannins, and phenolic acids, which may negatively affect seed germination, root development, and overall plant growth (Zhou *et al*., 2013; Dhaouadi *et al*., 2022). These allelochemicals could interfere with nutrient uptake, disrupt hormonal balance, or induce oxidative stress in sweet corn (Li et al., 2022; Talukder et al., 2020), ultimately reducing cob weight.

V. CONCLUSION

The results of the research showed that plants fertilized with a combination of Melastoma compost and synthetic fertilizer produced better plant growth as indicated by taller plants, more and broader leaves, larger stem diameters, and greater fresh weight and shoot and root weight compared to plants fertilized only with synthetic fertilizer or Melastoma compost. The combination of Melastoma compost and synthetic fertilizer produces corn whose weight, cob length and diameter, number of rows per Cob, and number of kernels per row are comparable to plants fertilized with synthetic fertilizer at the recommended dose. The findings suggest that integrating melastoma compost with synthetic fertilizer can enhance plant growth and maintain corn yield comparable to recommended synthetic fertilizer doses. This indicates the potential for reducing synthetic fertilizer use while sustaining productivity, contributing to more sustainable and environmentally friendly agricultural practices.

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VII. DISCLOSURE

The writing of this article does not have any element of conflict of interest with any parties.

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